



Ladyman, J. (2019). Introduction: Structuralists of the world unite. *Studies in History and Philosophy of Science Part A*, 74, 1-3.
<https://doi.org/10.1016/j.shpsa.2018.12.004>

Peer reviewed version

License (if available):
CC BY-NC-ND

Link to published version (if available):
[10.1016/j.shpsa.2018.12.004](https://doi.org/10.1016/j.shpsa.2018.12.004)

[Link to publication record in Explore Bristol Research](#)
PDF-document

This is the accepted author manuscript (AAM). The final published version (version of record) is available online via Elsevier at <https://doi.org/10.1016/j.shpsa.2018.12.004>. Please refer to any applicable terms of use of the publisher.

University of Bristol - Explore Bristol Research

General rights

This document is made available in accordance with publisher policies. Please cite only the published version using the reference above. Full terms of use are available:
<http://www.bristol.ac.uk/red/research-policy/pure/user-guides/ebr-terms/>

Introduction: Structuralists of the World Unite
James Ladyman
University of Bristol
James.ladyman@bristol.ac.uk

Keywords: French, Individuals, Real Patterns, Structural Realism, Structuralism

Abstract

Key arguments and claims in Steven French's *The Structure of the World* are articulated and assessed. Differences between different forms of ontic structural realism are articulated, and some problems raised for some aspects of French's version.

Steven French's *The Structure of the World* is a rich and rewarding defense of ontic structural realism. It is also an insightful guide to a range of fascinating issues and the literature about them, and so contains much even for those uninterested in its primary goal of establishing that "the fundamental ontology of the world is one of structures". It is characteristic of its author's extraordinary breadth and depth of learning, and exemplary attention to the work of others, as well as his generosity of spirit and charity as an interlocutor. Much of the book takes the form of dialectic with other voices comprehensively and fairly represented. French never shies from facing an objection or problem. The book makes important contributions to debates in a wide range of subjects from the interpretation of quantum field theory to analytic metaphysics. It is a difficult text in so far as familiarity with advanced physics and its history, and the corresponding philosophy is assumed, but it is as accessible as it could be while also being engaging and informative for experts.

I am in broad agreement with French about many issues; in particular, I think he is right that structural realism is the way forward in philosophy of science, and that quantum mechanics motivates metaphysical reform. I also agree that ontic structural realism is in part a commitment to objective modal structure in the concrete world, and that the model-theoretic approach to scientific representation is the correct one. However, French has much to say that goes far beyond these points, and his book addresses the existence of everyday objects, and elaborates an overall metaphysics; indeed in the last chapter he argues that his view applies to biology. In this paper I clarify some of the differences between different forms of ontic structural realism, raise some problems for some aspects of French's version, and make some other comments along the way.

Ontic structural realism, in the most general sense, is any view in philosophy of science that inflates the ontological status of structure and/or relations at the expense of individuals, objects and their intrinsic properties. The position was introduced (in Ladyman 1998) as an interpretation of John Worrall's (1989) structural realism as a metaphysical thesis to the effect that the ontology of physics should be based, not on objects and individuals, but on structure.

Worrall intended only to give a response to the problem of theory change for standard scientific realism. He repudiates this interpretation and denies that structural realism involves any metaphysical or ontological novelty. Accordingly, French's first chapter lays out standard scientific realism as formulated by Stathis Psillos (1999), which is explicit in positing reference to individuals, properties and relations, and identifies it as 'object orientated realism' (OOR). French presents the pessimistic meta-induction (PMI) as an argument against OOR and argues that it cannot respond to it, nor to two other problems. The latter are the problem of underdetermination, and 'Chakravartty's Challenge'.

Note that the idea that structure is often preserved on theory change even though ontological commitments change does not mean structural realists ought to be able to say of current theories what parts will be retained. Structure of various kinds also changes on theory change. Newton's planets do not follow perfectly elliptical orbits and so the exact structure of Kepler's laws is not retained. The point of structural realism is that even when ontological categories change radically (mass), or entities are dropped altogether (phlogiston), there can still be preservation of structure and more than the purely empirical content of the old theory is retained. French rightly does not defend structural realism as a form of 'selective realism' in the sense that is often discussed in the literature (see Ladyman 2018).

The underdetermination French has in mind is not the standard underdetermination of theory by evidence, but rather the fact that physics admits of a diversity of interpretations. The metaphysical nature of the individuals of OOR is left wide open. The most important example of this for French is non-relativistic many-particle quantum mechanics. On the orthodox view within physics, particles of the same species, such as electrons, may lack determinate spatio-temporal trajectories and enter into states in which two or more of them cannot be distinguished by any physical features. Indeed, this is often taken to be the basis of quantum statistics. This means that they violate the standard form of the Principle of the Identity of Indiscernibles (PII), according to which for any two distinct individuals there is a qualitative property that one has and the other lacks. (It is assumed that being qualitative rules out properties like being identical to a particular particle.) French showed, in seminal work with Michael Redhead (1988), that the theory can be interpreted as describing a collection of individuals being imbued with some kind of primitive identity. If quantum particles can be taken to be individuals, but the standard view that they are is also consistent, then their metaphysical nature is underdetermined.

In order to put flesh on the bones of the conception of quantum particles as somehow real, but not individual objects, French, building on previous work with Decio Krause (2006), argues that there is a formal framework in which quantum particles can be represented as non-individual objects, in a language in which the identity relation is not defined for them. He also discusses the argument of Simon Saunders (2006) and others that they can be discerned after all (albeit weakly in the sense discussed below). The upshot of all this is that the metaphysical nature of any putative quantum objects is underdetermined. This is

the second problem for OOR, and the prime motivation for abandoning objects for structure.

Ladyman (1998) argued that French's idea of metaphysical underdetermination also applies to spacetime points. OSR is motivated by the fact that prioritizing individuals in thinking about the ontology of physics in twentieth century and beyond does not seem apt. In the light of both quantum and spacetime physics, and the highly abstract and mathematicised nature of descriptions and models of unobservable reality, departures from the metaphysics of individuals derived from the analysis of the manifest image are required. French deploys the example of spacetime to show that the category of structure is preferable to that of individuals and objects for the ontology of current physics.

The third problem for OOR is provide a "clear picture" of realist ontology. French argues that the way to do this is to take physics at face value, and to reject the demand for epistemic humility motivated by the thought that there are facts about the metaphysical nature of objects beyond our ken. According to French, physics tells us that laws and symmetries are the fundamental structures of the world. The properties they relate are metaphysically dependent on the fundamental structures not vice versa. There are no natures beyond this because there are no objects or individuals at all. This does not mean abandoning realism because there is an alternative ontological category available, namely that of structure.

In the next chapter, having motivated OSR, French looks for inspiration in elaborating it in the history of structuralism. Epistemic forms of structural realism are related to Russell's structuralism in *The Analysis of Matter*. One version of epistemic structural realism takes the Ramsey sentence of a theory to express its structural content, and so regards Carnap as a proto-structural realist. French rejects these forms of structuralism, for all their logical sophistication, for their failure to take account of developments in physics. The 'lost history' of structuralism concerns the ideas of Cassirer, Eddington, and others, who took group theory and symmetry to be of paramount importance, and who took relations to be prior to objects.

French develops his version of the semantic view to represent the structure of theories, but argues it is neutral in respect of realism and antirealism and the debate about which form of structural realism should be adopted if any. He is happy with pluralism about scientific representation and develops the partial structures account as his preferred one, taking pains to point out that the formalism is a tool for representing the physics and not the subject matter of the physics. He also discusses the idea of group-theoretic structure in detail and considers an argument of Bryan Roberts (2011) that taking group theoretic structure ontologically seriously leads to regress. Here French emphasizes that the structure to which OSR is committed is the dynamical structure of the world and not the abstract structure of the mathematics we use to formulate physical theories.

The elaboration of ontic structural realism (OSR) in response to Chakravartty is the subject of four chapters. The notion of structure must be given metaphysical content. French argues that the resources of current analytic metaphysics can be used to do this. In particular, they are needed to provide accounts of ontological dependence, supervenience and truth-making for quotidian statements about objects. He also argues against versions of OOR that articulate it in terms of dispositions, while agreeing with the rejection of Humeanism, and defending realism about causation and modal structure. The book ends with a consideration of unitary inequivalence in quantum field theory, and the prospects for structural realism about biology.

The defining features of French's version of OSR are these:

- (1) Structure and relations are fundamental.
- (2) Objects and individuals are eliminable.
- (3) Laws and symmetries are primitive modal features of the world.

There is disagreement about OSR among its advocates to such an extent that only (1) is adhered to universally, and there is also disagreement about the arguments that motivate it. For example, some of those discussing versions of OSR in philosophy of physics do not take it to be anything to do with the problem of theory change for scientific realism. Among them is Michel Esfeld (2017) who argues for a Humean version of OSR and so denies (3). He and other advocates of 'moderate' views also deny (2) above, arguing only that relations must be taken as irreducible, not that everything else reduces to them.

French and Ladyman (2003) argued that a commitment to modal structure is key to OSR, and Ladyman and Ross (2007) devote a whole chapter to 'Causation in a Structural World'. Despite this it is often argued that OSR cannot support a realist view of causation. French argues at length that it can. The significant differences between the version of ontic structural realism defended by Ladyman and Ross (2007) and that of French have to do with (2), though they also extend to broader disagreement about metaphysics and very general questions about naturalism and ontology. In particular, firstly, French accepts that (2) entails that everyday and special science ontology does not exist. Hence, for him, OSR in the philosophy of physics requires eliminativism about both everyday objects and the entities of the special sciences, in favour of the structures of fundamental physics. Scientific realism is usually formulated to refer to science rather than physics, yet many scientific realists are eliminativists about the ontology of the special sciences. On the other hand, Ladyman and Ross develop OSR in conjunction with an ecumenical attitude to ontology that takes the objects, processes and properties of the special sciences at face value (see Ladyman 2017 for a summary).

Secondly, French makes use of concepts and theories from recent analytic metaphysics to articulate OSR, in particular to give an account of non-fundamental truth-makers for quotidian truths; and thirdly, French more generally takes the demands of analytic metaphysicians seriously.

(2) above requires clarification. When structural realists say there are no objects and/or that there are no individuals, the relevant notion of object and/or individual must be specified. For example, Ladyman and Ross eschew 'self-subsistent objects' and 'things' conceived of along the lines of tiny billiard balls. However, this is compatible with accepting the existence of things in the quotidian sense. The negative theses of OSR that not all relational structure supervenes on objects and their intrinsic and spatio-temporal properties and relations, and that there are no self-subsistent individuals, need not conflict with the existence of objects and maybe even individuals if these are construed in an ontologically thin way.

Although French stresses the need to eliminate individuals and objects from ontology, he is not explicit about how either category is to be characterised, and, in particular, about what the difference between individuals and objects is supposed to be. Standardly an object in philosophical logic is taken to be the value of a first order variable, the subject of predication, and perhaps also a special-temporal particular. It seems that structures count as objects in all these senses for French. If we ask what makes for an individual over and above an object, we find several answers in the literature, namely, identity over time, identity across worlds, countability, and absolute discernibility (see Ladyman 2015). French denies that there are individuals in any of these senses, but it is not clear why. Even if quantum particles are not individuals, everyday objects seem to be individuals in most if not all of these senses.

Metaphysicians often discuss theories of identity conditions for composite objects and associated accounts of composition that render everyday and non-fundamental scientific objects problematic. Ladyman and Ross argue that we do not need to have exact identity conditions to admit them in our ontology, but only FAPP (for all practical purposes) well-defined identity conditions in accordance with the theory of real patterns (see also Wallace 2015). They disagree with French on eliminativism, but agree that reductionism is not plausible and that we can neither give reductive truth conditions for sentences about tables, nor establish token-token identities between special science objects and the objects of physics. Rather, science gives us dynamic accounts of composition that make the existence of objects and individuals scale relative. French argues for structure at the fundamental level. However, OSR as defined above is clearly compatible with there being no fundamental level. Indeed, the issue of how the ontologies of different sciences relate is not addressed at all by OSR per se. As French accepts, the arguments for the elimination of ordinary objects cut also against scientific properties and relations (structure) and objects outside of fundamental physics. This is a very strong form of eliminativism about scientific ontology and arguably conflicts with naturalism, in the sense of the methodological requirement on philosophers to take the sciences at face value by default.

French argues that a sentence like 'tables exist' can be true when the underlying constituents of tables exist, though tables are not an ontological commitment of the theory of the world. Similarly, it is true that 'atoms exist', but also that there are no atoms. This may be fine for those habituated to the semantic contortions

demanding by metaphysical theories, but it is revisionary in the extreme. Furthermore, it requires us to say that nothing exists except the fundamental structures that we might one day discover, because, we currently do not have the true fundamental physical theory. French does not want an inflated ontology, but science already uses Ockham's razor to avoid unnecessary posits, and has discovered the existence of all manner of entities, many of which have become part of our massively expanded quotidian ontology.

The idea that metaphysics is to philosophy of science as pure mathematics is to physics, is typical of French's charitable approach, but it is undermined by the fact that a priori metaphysics is conceptually conservative whereas a priori mathematics is the opposite. It is the radical conceptual nature of mathematics that has enabled it to support science. The key ideas that are necessary for an adequate understanding of the relationship between physics and the special sciences, are those of emergent effective dynamics, information compression, the renormalization group and scale-relative degrees of freedom. They come from science, not from metaphysics.

References

- Esfeld, Michael and Deckert Dirk-André (2017) *A minimalist ontology of the natural world*. New York: Routledge.
- French, Steven, and Krause, Décio (2006) *Identity in Physics: A Formal, Historical and Philosophical Approach*. Oxford: Oxford University Press.
- French, Steven, and Redhead, Michael (1988) *Quantum Physics and the Identity of Indiscernibles*. British Journal for the Philosophy of Science 39: 233–246.
- French, Steven and Ladyman, James (2003), 'Remodelling Structural Realism: Quantum Physics and the Metaphysics of Structure', *Synthese* 136 (1): 31-56.
- Ladyman, James (1998), 'What is Structural Realism?', *Studies in History and Philosophy of Science* 29 (3): 409-424.
- Ladyman and Ross (2007), *Every Thing Must Go: Metaphysics Naturalised*, Oxford University Press.
- Ladyman, J. (2015), 'Are There Individuals in Physics, and If So, What Are They?', in Guay, A. and Pradeu, T. (eds.) *Individuals across the Sciences*, Oxford University Press, 193-206.
- Ladyman, J. (2017), 'An Apology for Naturalised Metaphysics', in Slater, M. and Yudell, Z. (eds.) *Metaphysics and the Philosophy of Science*, Oxford University Press.

Ladyman, J. (2018) 'Scientific Realism Again', in *Spontaneous Generations: A Journal for the History and Philosophy of Science*, 9(1).

Roberts, Bryan (2011), 'Group Structural Realism'. *The British Journal for the Philosophy of Science*, Volume 62, Issue 1, 1 March 2011, Pages 47–69.

Saunders, Simon (2006), 'Are Quantum Particles Objects?' *Analysis* 66: 52–63.

Wallace, David (2015), *The Emergent Multiverse*. Oxford: Oxford University Press.

Worrall, J. (1989). 'Structural realism: The best of both worlds?'. *Dialectica*, 43(1 - 2), 99-124.